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February 19, 1997

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Federal Communications Commission
Office of Secretary

Written Ex Parte

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W.
Room 222
Washington, D.C. 20554

Re: Local Telephone Number Portability, CC Docket No. 95-116

Dear Mr. Caton:

With this letter and attachments, Southwestern Bell Telephone Company (SWBT) supplements its ex parte letter of February 10, 1997 in the above-captioned docket. A copy of the February 10th ex parte letter is attached for your convenience.

As previously indicated, on February 7, 1997, Link Brown and Gary Fleming of SWBT met with Mr. Richard Metzger and Ms. Linda Kinney of the FCC's Common Carrier Bureau to discuss issues relating to the implementation of number portability, specifically Query on Release ("QOR") and the implementation schedule.

As previously indicated, the SWBT representatives referenced a network reliability study, conducted by Bellcore, that quantifies the probability of a catastrophic network failure in the Houston MSA and other MSA's utilizing the FCC's proposed technology and schedule versus an alternate technology (QOR) and alternate schedules. Specifically, the study indicates that the introduction of LNP as ordered by the FCC will create a .435 percent probability of a catastrophic network outage in Houston which is over 35 times the current chances of a catastrophic network outage in Houston. The study results are attached.

In addition, an independent article titled "Does Completion Mean Tie-Ups?" contained in the publication "Interactive Week" dated January 27, 1997 discusses potential network reliability concerns associated with the implementation of number portability as prescribed by the FCC in the above-captioned docket. A copy of this article is also attached.

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As indicated in SWBT's February 10th ex parte letter, SWBT also provided proposed changes to the current implementation plan which will meet the FCC's goals to begin implementation October 1, 1997 and complete by December 31, 1998 while significantly reducing the risk of a serious network outage.

Please do not hesitate to contact me at (202) 326-8890 if you have any questions.

Sincerely,

Link Brown

Attachment

cc: Mr. Metzger (w/attachment)
        Ms. Kinney (w/attachment)

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OFFICE OF SECRETARY

Re: Local Telephone Number Portability, CC Docket No. 95-116

Dear Mr. Caton:

In accordance with Commission rules, please be advised that Friday, February 7, 1997, Gary Fleming and the undersigned, representing Southwestern Bell Telephone Company ("SWBT"), met with Mr. Richard Metzger and Ms. Linda Kinney of the Common Carrier Bureau to discuss issues associated with the above-referenced docket, specifically Query on Release ("QOR") and the implementation schedule for local number portability.

In the meeting, information was provided regarding the cost savings associated with QOR, differences imperceptible to customers, in call set-up time with LRN and/or QOR and their service quality implications, regional database solutions associated with LRN and QOR, and end-office processor crossover thresholds for LRN and QOR. In addition, SWBT committed not to use any differences in call set-up time between LRN and QOR in any advertising and SWBT further committed not to use vendor availability of QOR as the basis for a waiver of the local number portability implementation schedule.

Information was also provided regarding network reliability concerns and the current implementation schedule. Specifically, the company commissioned a study, produced by Bellcore, the preliminary results of which indicate the increased risk of a catastrophic network failure in the Houston MSA if the current implementation schedule without QOR remains intact. SWBT will supplement this ex parte letter with the actual Bellcore study when it becomes available. It was also indicated that SWBT based on what we know now, could accomplish the

implementation of local number portability within the start and complete dates (October 1, 1997 and December 31, 1998 respectively) of the current schedule if only the Houston MSA, the St. Louis MSA and the Dallas MSA completion dates were extended three months.

Such a limited change in the implementation schedule would prevent the increased risk of a catastrophic network failure and still accomplish the implementation of Local Number Portability within the time frame contained in the Commission's order.

Please do not hesitate to contact me at (202) 326-8890 if you have any questions.

Sincerely,

cc: Ms. Metzger
        Ms. Kinney

Bellcore

@ Bell Communications Research

Quantification of the Effects of Local Number Portability on the Reliability of Southwestern Bell's Network

John Healy
Wayne Felts
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Quantification of the Effects of Local Number Portability on the Reliability of Southwestern Bell's Network
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Quantification of the Effects of Local Number Portability on the Reliability of Southwestern Bell's Network

Executive Summary

The purpose of this study is to quantify the effects of the introduction of Local Number Portability (LNP) on the Southwestern Bell (SWB) network. Since the FCC Order in CC Docket 95-116 directs that LNP be introduced first in the Houston, Texas, Metropolitan Statistical Area (MSA), the study focuses on that area, but the conclusions should be more generally applicable.

The details of the implementation of LNP are evolving over time. This may change some of the assumptions that are the basis of this document. As such, these results may change as LNP is implemented.

The principal conclusions of the study are:

1. The FCC order which directs the implementation of LNP departs from the telecommunications industry's traditional methods for introducing new network capabilities and requires:

   a) First introduction in the largest MSA in SWB's network (Houston)

   b) Implementation on an accelerated schedule that will not allow sufficient time for testing, integration, and soaking (limited use of the software in a live environment for a length of time sufficient to find initial defects) of the software

   c) Refusal to allow use of techniques for reducing signaling network traffic and thus insuring a large increase in signaling network traffic over a short time period

   d) Implementation during one of the busiest seasons of the year for telephone traffic.

   These factors provide the ingredients of a recipe for failure in the SWB network in Houston.

2. Calculations indicate that the introduction of LNP as ordered by the FCC will create a 0.435% probability of a catastrophic network outage[1] in Houston during the quarter following LNP implementation which is over 35 times the current chances of a catastrophic network outage in Houston. Such an outage could potentially affect most or all calls within the Houston area for times ranging from a few seconds up to several hours. To put 0.435%

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[1] Most of these catastrophic outages are due to a simultaneous failure of all LNP databases. We have assumed that such a failure will cause all the intraLATA, interoffice calls to time out and that the simultaneous timing out of all these calls will cause overloads in the local switches. The local switch manufacturers are aware of the problem and their solutions to the problem will be tested in the next few months. This study assumes that they will not be successful. In addition, there may be other undiscovered failure modes that have similar effects. Note that as of February 10, 1997 there have been no dual failures of Bellcore ISCPs (the LNP database that SWB plans to use in Houston.).

February 10, 1997

in perspective, consider that the Network Reliability Council (NRC) was chartered by the FCC to address network reliability in response to several outages which had at most a probability of 0.75% per quarter of occurring. That is, the entire telecommunications industry was mobilized by a 0.75% chance of a catastrophic outage.[2] Since LNP will be implemented in 6 other large MSAs, the chance of a catastrophic outage somewhere in the U.S. is about 3.1% (= 7 • 0.435%).

3. With a normal schedule for the introduction of LNP using Location Routing Number (LRN), the probability of a catastrophic outage is 0.048%. With the FCC mandated schedule, the probability is 0.435%. Thus, the accelerated introduction of LNP as mandated by the FCC increases the chances of a catastrophic outage by a factor of 9 compared with the normal introduction. With the FCC mandated schedule for the introduction of LNP, if LRN augmented with Query on Release (QoR) is permitted, the probability of a catastrophic outage is 0.073% if less than 1% of the numbers are ported. With QoR under a normal schedule, the probability of a catastrophic outage is reduced to 0.012% (which is the same as the probability prior to the implementation of LNP) if less than 1% of the numbers are ported.

4. Calculations indicate that the introduction of LNP as ordered by the FCC will create a 65.9% probability of an FCC reportable outage during the quarter following LNP implementation. Such an outage would potentially affect calls from 30,000 or more lines and last for at least 30 minutes. The introduction of LNP in the way defined by the FCC, increases the probability of an FCC reportable outage by 4.5 times.

5. Calculations indicate that the expected number of total local switch outages in Houston will increase from 1.31 to 8.78 (a factor of 6.7) with the FCC mandated approach compared with the normal introduction of a major network service[3].

The report includes several recommendations for reducing the risk associated with the introduction of LNP. These recommendations are:

1. Extend the time interval for introduction of LNP by 3 months. This will allow additional time for software testing, integration of the many affected network components, and soaking of the new software. It will also avoid requiring that the initial implementation in Houston be done during the fourth quarter of 1997, which is traditionally one of the busiest seasons of the year.

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[2] According to the Signaling Team Report contained in **Network Reliability: A Report to the Nation,** the chances of a catastrophic failure due to a pair of STPs failings were 3% per year or 0.75% per quarter. "If we exclude, the major outages of June and July, the number falls to 0.04%" per year or 0.01% per quarter.

[3] The normal introduction of a network capability involves the definition of the capability, identification of all affected network components, preparation and testing of new software and hardware as needed, development of operations plans, installation and testing of new hardware and software, integration testing and soak of new hardware, software, and procedures within a carrier's network, and intercompany testing and soak. For a network capability such as LNP, first introduction of a complex network capability throughout all carrier networks in a smaller MSA than Houston would typically take several months.

2. Confine the risk of network failures or degraded service to a smaller area. This could be done by selecting a smaller market area, such as El Paso, for the first introduction of LNP or by confining the LNP introduction to a few central offices in the Houston MSA.

3. Adopt the use of a query reduction technique such as Query on Release (QoR). This technique can substantially reduce the number of queries to the LNP databases required to complete calls and can thus reduce the CCS network load, reduce the reliance on the LNP databases for call processing, and reduce the number of LNP databases that are required.

Quantification of the Effects of Local Number Portability on Southwestern Bell's Network

John Healy
Wayne Felts
Roger Story

1. Introduction

1.1 Background

On June 27, 1996, the FCC issued its order on CC Docket No. 95-116 on the subject of Local Number Portability (LNP). In its LNP mandate, the FCC declined to choose a particular technology or architecture. Instead, the FCC established a set of performance criteria that any long-term solution for LNP must meet, and ordered an introduction methodology and schedule. Although several different approaches were initially considered, only two remain: the pure LRN approach and the LRN approach augmented with QoR. For brevity, we will refer to the pure LRN approach as "LRN" and the LRN approach augmented with QoR as "QoR". The QoR approach was initially rejected by the FCC, but this decision has been appealed by several Regional Companies because of the potential cost savings and reliability benefits.

In the LRN approach, a database query to obtain routing information is launched in the N-1 network on all interswitch calls to portable NPA-NXXs (i.e., NPA-NXXs from which numbers can be ported to other carriers) in the area of portability. If the dialed number is outside the area of portability (e.g., an interLATA call), it is routed as today (i.e., to the interLATA carrier). It is generally assumed (but not ordered by the FCC) that if there are N networks involved in a call, the network prior to the terminating network (hence the N-1 network) is responsible for performing the query to obtain routing information. For intraMSA calls, the N-1 network is the originating network unless an intraLATA carrier is required. In most instances, the N-1 network will be the network in which the call originates for intraMSA calls.

With QoR, the signaling message for call set-up is routed to the "native" switch that serves the NPA-NXX of the dialed (called) number (called the "donor" switch). If the dialed number still resides at that switch, the call completes normally. If the dialed number has been ported to another switch, a previous switch in the call path (called the "initiating" switch), upon receiving the SS7 Release message, launches a database query to obtain routing information. The call is then routed to the new switch (called the "recipient" switch).

The FCC order on LNP included network reliability in its list of performance criteria that any long-term solution for LNP must meet. In particular, the criterion requires that implementation of an LNP solution "not unreasonably degrade existing service quality or network reliability."

Bellcore was asked to conduct a study to quantify the effects of LNP (both the LRN approach and the QoR approach) for Southwestern Bell (SWB). SWB was particularly interested in

quantifying the effects in Houston, Texas where its first implementation of LNP will take place. Based on the first conference call, SWB wanted a quantification of the probability of catastrophic outage and the effects on network traffic. SWB also wanted a listing of major issues affecting network reliability that we could not quantify.

The details of the implementation of LNP are evolving over time. This may change some of the assumptions that are the basis of this document. As such, these results may change as LNP is implemented.

1.2 Summary of Results

Southwestern Bell asked Bellcore to conduct a study quantifying the effects of LNP on the reliability of their network. For this study, we define two levels of major outage:

- The probability of an FCC reportable outage, i.e., an outage that potentially affects 30,000 or more subscribers for 30 or more minutes.
- The probability of catastrophic outage, i.e., losing all intraLATA interoffice service for most or all of Houston.

Table 1 provides a summary of the effects on reliability for the first implementation of LNP in Houston. All Probabilities are for the first Quarter after LNP implementation.

John Healy
Wayne Felts
Roger Story

Table 1: Summary of Principal Results

Description - All Entries are Quarterly Figures	Without LNP	With LRN (Normal Schedule)	With LRN (FCC Schedule)	With QoR: < 1% Ported (Normal Schedule)	With QoR: < 1% Ported (FCC Schedule)	With QoR 10% Ported (FCC Schedule)
Prob of a Catastrophic Outage in Which Both STPs Fail Simultaneously	0.012%	0.012%	0.073%	0.012%	0.073%	0.073%
Prob of a Catastrophic Outage in Which All LNP Databases Fail Simultaneously	0	0.036%	0.362%	0	0	0
Prob of a Catastrophic Outage	0.012%	0.048%	0.435%	0.012%	0.073%	0.073%
Expected Number of Local Switch Outages Longer than 5 minutes	1.31	1.31	8.78	1.31	8.78	8.78
Expected Number of Local Switch FCC Reportable Outages	0.1595	0.1595	1.07184	0.1595	1.07184	1.07184
Expected Number of FCC Reportable Outages in Which a Pair of STPs Fail Simultaneously	0.00012	0.00012	0.00073	0.00012	0.00073	0.00073
Expected Number of FCC Reportable Outages in Which All LNP Databases Fail Simultaneously[4]	0	0.00036	.00362	0	0	0.0020
Expected No. of FCC Reportable Outages	0.1596	0.1600	1.076	0.1596	1.0726	1.0746
Prob of an FCC Reportable Outage	14.75%	14.78%	65.9%	14.75%	65.8%	65.9%

Note: In Table 1, we give both the probabilities that some events will occur and the expected number of occurrences of those events. Converting from an expected number to the probability that at least one event occurs assumes that the number of events follows a Poisson distribution. The following equation is used to convert the expected number to the probability that at least one event occurs:

$$P = 1 - e^{-m}$$

where: P = probability of an event
m = expected number of events

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[4] Note: This is a calculated number. As of February 10, 1997, there have been no dual failures of Bellcore ISCPs (which will be used as LNP databases by SWB in Houston).

We illustrate this simple conversion with FCC reportable outages with no LNP implementation. In this case m=0.1596. Then,

$$P = 1 - e^{-0.1596} = 1 - .852 = .148 = 14.8\%$$

Clearly we could convert from the probability that at least one event occurs to the expected number of events by inverting the above equation:

$$m = -\ln(1 - P)$$

where "ln" indicates the natural log.

Some important results from the table:

- The introduction of LNP using the techniques ordered by the FCC will create a 0.435% probability of a catastrophic network outage[5] in Houston during the quarter following LNP implementation, which is over 35 times the probability of a catastrophic network outage in Houston if LNP were not introduced there. Such an outage could potentially affect most or all calls within the Houston area for times ranging from a few seconds up to several hours.
- With a normal schedule for the introduction of LNP using LRN, the probability of a catastrophic outage is 0.048%. With the FCC mandated schedule, the probability is 0.435%. Thus, the accelerated introduction of LNP as mandated by the FCC increases the chances of a catastrophic outage by a factor of 9 compared with the normal introduction. With the FCC mandated schedule for the introduction of LNP, if LRN augmented with Query on Release (QoR) is permitted, the probability of a catastrophic outage is 0.073% if less than 1% of the numbers are ported. With QoR under a normal schedule, the probability of a catastrophic outage is reduced to 0.012% (which is the same as the probability prior to the implementation of LNP) if less than 1% of the numbers are ported.
- The introduction of LNP as ordered by the FCC will create a 65.9% probability of an FCC reportable outage during the quarter following LNP implementation. An FCC reportable outage is defined as an outage that would potentially affect calls from 30,000 or more lines and last for at least 30 minutes. The introduction of LNP in the way defined by the FCC, increases the probability of an FCC reportable outage by 4.5 times. These figures are driven by complete outages of local switches.

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[5] Most of these catastrophic outages are due to a simultaneous failure of all LNP databases. We have assumed that such a failure will cause all the intraLATA, interoffice calls to time out and that the simultaneous timing out of all these calls will cause overloads in the local switches. The local switch manufacturers are aware of the problem and their solutions to the problem will be tested in the next few months. This study assumes that they will not be successful. In addition, there may be other undiscovered failure modes that have similar effects. Note that as of February 10, 1997 there have been no dual failures of Bellcore ISCPs (the LNP database that SWB plans to use in Houston.).

- The expected number of total local switch outages longer than 5 minutes in Houston will increase from 1.31 to 8.78 (a factor of 6.7) with the FCC ordered schedule compared with the normal introduction (see footnote in Executive Summary) of a major network service.

The numbers in Table 1 were based on quantifying the many factors which will be affected by the implementation of LNP. Below is a list of some factors that influence the reliability of LNP - the list is not exhaustive:

- Introduction of a new network capability (number portability) throughout SWB's largest MSA, Houston, during the three busiest months of the year (fourth quarter) for telephone traffic.
- New nodes in the network (LNP databases) with new hardware and software (ISCP Release 5.1) on them, and these nodes are necessary for calls to be established to ported numbers (i.e., calls cannot complete to numbers that are ported from SWB's network to other networks).
- Unknown loads and untested engineering rules that may result in overloaded network nodes.
- Short introduction interval with inadequate time for testing, soak, and problem resolution.
- Inadequate requirements - with known message looping problems that have not been resolved in the initial Illinois requirements that most of the industry is using. Vendors trying to provide proprietary work-arounds and no one has gotten industry consensus.
- A large step function increase in CCS network traffic.
- New hardware and software in existing switches.
- Some new switches will probably be needed to handle the load. The activity involved in installing and turning up the new switches provides a failure source.
- New software and translations in STPs - including new DSC STP loadsharing software to share over multiple LNP databases.
- New intercompany procedures for porting numbers and getting translations information between carriers.
- Introduction of new operations systems, i.e., the regional SMS, and the SWB local SMS.
- Unanticipated query loads because of the use of default routing to the SWB network by other carriers. The default routing can be continuous (because the N-1 carrier does not perform an LNP database query) or can be sporadic and unpredictable (because of an LNP database failure in the other network(s).)

In fact, it is difficult to imagine a situation where there are more factors that could increase the chances of an FCC-reportable or a catastrophic failure.

Table 2 summarizes the list of failure scenarios, our current information on the probability of their occurring, and the effect they would have if they occurred for LRN, for QoR with less than 1% of the numbers ported, and for QoR with about 10% of the numbers ported. All probabilities are for the 1st Quarter (3 months) after implementation.

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Table 2: Effects of Failure Scenarios for LNP

Failure Scenario	Effect for LRN	Prob. for LRN	Effect for QoR Initially (less than 1% ported)	Effect for QoR with 10% Ported	Prob. for QoR
Local switch failure due to new software	FCC-Reportable	200% Increase	FCC-Reportable	FCC-Reportable	200% Increase
Local switch failures due to rapid deployment after soak	FCC-Reportable	12% Increase	FCC-Reportable	FCC-Reportable	12% Increase
Local switch failures due to short soak period	FCC-Reportable	100% Increase	FCC-Reportable	FCC-Reportable	100% Increase
Local switch failures due to increased traffic and overloads	FCC-Reportable	Depends on Update Strategy	FCC-Reportable	FCC-Reportable	Depends on Update Strategy
Both STPs fail due to common failure mechanism (e.g. common software) in a year - Baseline	Catas-trophic	0.012%	Catas-trophic	Catas-trophic	0.012%
Both STPs fail due to common software that is new (for first 3 months)	Catas-trophic	200% increase	Catas-trophic	Catas-trophic	200% Increase
Both STPs fail due to short soak period	Catas-trophic	100% Increase	Catas-trophic	Catas-trophic	100% Increase
STP failures due to increased CCS load	Catas-trophic	Negligible	Catas-trophic	Catas-trophic	Negligible
STP loadsharing software inducing all LNP databases to fail	Catas-trophic	Not quantified	Minor	FCC-Reportable	Not quantified
All LNP databases fail due to common failure mechanism (e.g. common software) in a year - Baseline	Catas-trophic	0.036%	Minor	FCC-Reportable	0.036%
All LNP databases fail due to common software that is new (for first 3 months)	Catas-trophic	200% increase	Minor	FCC-Reportable	200% Increase
All LNP databases fail due to rapid deployment after soak	Catas-trophic	12% increase	Minor	FCC-Reportable	12% Increase
All LNP databases fail due to short soak period	Catas-trophic	200% Increase	Minor	FCC-Reportable	200% Increase
All LNP databases fail due to overload	Catas-trophic	Negligible With 4 ISCPs V5.1	Minor	FCC-Reportable	Negligible

Comment: Most failure scenarios could result in an FCC reportable outage. The ones with a "catastrophic" in the second column could result in all of Houston being simultaneously out of service for interoffice calls. For LRN, we assume that, if all the LNP databases are down, the long processing times of each call will result in the network being paralyzed. We have assumed that a failure of all the LNP databases will cause all the intraLATA interoffice calls to time out and that the simultaneous timing out of all these calls will cause overloads in the local switches. The local switch manufacturers are aware of the problem and their solutions to the problem will be tested in the next few months. This study assumes that they will not be successful. In addition, it is unclear how customers will react to about an extra 3 seconds in the call set-up time. There may be other undiscovered failure modes that have similar effects.

Comment: In this comment, we show how some of the information from Table 2 was used to obtain information for Table 1. Currently local switches fail very infrequently. In 1996, there were 30 FCC reportable local switch failures in the U.S. There are about 1350 local switches in the U.S. with over 30,000 lines. This means that there is about a 2.2% chance that an individual switch (over 30,000) lines will have an FCC reportable outage in a year. In a quarter, the chance a switch will experience an FCC reportable outage is 0.55%. There are 29 switches in Houston with over 30,000 lines. The expected number of FCC reportable outages due to local switch outages is 29 * 0.55% or 0.1595 (see Table 1). The expected number of FCC reportable with new software is 3* 0.1595. When LRN is introduced, we calculated the following (using information from Table 2):

Table 3: Expected FCC Reportable Outages Due to Local Switches with LRN

Expected number of FCC reportable outages in Houston due to local switches (with no software changes)	0.1595 - from Table 1
Multiplier for new software for LRN	3 (200% increase) - from Table 2
Multiplier for shortened soak	2 (100% increase) - from Table 2
Multiplier for rapid introduction after soak	1.12 (12% increase) - from Table 2
Resulting expected number of FCC reportable outages in Houston due to local switches with LRN	1.07184 = 0.1595 * 3 * 2 * 1.12 (See Table 1)

Comment: There are 79 local switches in Houston. The expected frequency per quarter of switch outages longer than 5 minutes came from the NRC Report: it is 1.65. To get the entry for LRN, we calculated 8.78 = 1.65 * 3 * 2 * 1.12 (see Table 1). The multipliers 3 (a 200% increase), 2 (a 100% increase) and 1.12 (a 12% increase) all came from Table 2.

Comment: Table 2 can be used to compare the chances of losing all LNP databases with the FCC mandated implementation of LRN with the chances of losing all LNP databases with a normal implementation, i.e., LRN is introduced initially in a smaller market area, very gradually, and with a long soak. The probability is increased by a factor of 10:

Table 4: Expected LNP Database Outages with LRN

Expected number of times all LNP databases simultaneously fail in Houston due to LRN with normal implementation	0.00036 - from Section 7
Prob of losing all LNP databases simultaneously in Houston due to LRN with normal implementation	$0.036\% = 1 - e^{-0.00036}$
Multiplier for new software for LRN	3 (200% increase) - from Table 2
Multiplier for shortened soak	3 (200% increase) - from Table 2
Multiplier for rapid introduction after soak	1.12 (12% increase) - from Table 2
Expected number of times all LNP databases simultaneously fail with LRN assuming FCC mandated implementation	$.00362 = 0.00036 * 3 * 3 * 1.12$ (See Table 1)
Probability of losing all LNP databases with LRN assuming FCC mandated implementation	$0.36\% = 1 - e^{-.0036}$

Comment: The details of how the entries in Table 2 were obtained can be found in Sections 3-8.

2. FCC-Mandated Introduction Methodology

In its order dated July 2, 1996, the FCC ordered that Local Number Portability (LNP) be introduced in the 100 largest Metropolitan Statistical Areas (MSAs) beginning in October, 1997 and concluding by December 31, 1998. This aggressive schedule is designed to meet objectives as contained in a congressional directive and does not appropriately consider network reliability needs. Implementation of the order is focused on implementing LNP in the largest MSAs in the country as rapidly as possible in order to foster competition in the largest markets. The SWB MSAs affected and the introduction schedule are shown in Table 5.

Table 5: SWB MSA Schedule

MSA	Start Date	End Date
Houston, TX	10/97	12/97
Dallas, TX	1/98	3/98
St. Louis, MO	1/98	3/98
Kansas City, KS	4/98	6/98
Fort Worth, TX	4/98	6/98
San Antonio, TX	7/98	9/98
Oklahoma City, OK	7/98	9/98
Austin, TX	7/98	9/98
El Paso, TX	10/98	12/98
Little Rock, AR	10/98	12/98
Tulsa, OK	10/98	12/98
Wichita, KS	10/98	12/98

There are two significant problems in the FCC-ordered implementation schedule for the introduction of LNP:

1. The introduction of LNP is to be done on an accelerated schedule that doesn't allow adequate time for testing. The schedule does not provide adequate time for preparation of the necessary new nodes and software, testing the nodes in a standalone mode, performing intranetwork integration testing, and performing internetwork integration testing.

   The FCC mandated trial in Illinois is due to complete by August 31, 1997, and the trial report is due 30 days after completion of the trial (September 30, 1997). Since implementation in Houston is due to begin on October 1, 1997, there will be no opportunity to include lessons learned from the Illinois trial in the Houston implementation, and, more importantly, it is likely that supplier changes made as a result of the Illinois trial will not be incorporated in the software and hardware used in Houston. Further, some of the network elements and software systems to be used by SWB in Houston will not be tested in the Illinois trial.

2. The FCC-ordered introduction applies to geographic areas where the most customers and calls can be affected. Best practices in the past have dictated that new capabilities be introduced in such a way that the minimum number of end users will be affected by network failures that result from the introduction.

It is instructive to compare the situation and timeframes that the FCC mandated for introduction of LNP and the introduction of 800 number portability. Table 6 provides the comparison.

Table 6: Comparison of FCC Mandates for 800 and LNP Introduction

	800 Number Portability	Local Number Portability
Scope	Calls to 800 Numbers (about 224 Million for Houston in 1997)	Calls to all local numbers (about 7.8 Billion for Houston in 1997)
Initial Conditions	Working LEC SCP, SSPs, and SMS. Little CCS deployment.	No working LEC SCP, SSPs, or SMS. Extensive CCS deployment
Mandated Working Date	March, 1993 (later extended to May, 1993)	December, 1997
Date of FCC Order	September, 1991	July, 1996
Interval from order to working	22 Months (with extension)	17 Months
Time of year	1st quarter (moved to 2nd quarter to avoid testing during 4th quarter busy season)	4th quarter (busy season)

It is readily seen that the network reliability aspects of the introduction of national 800 number portability pale in comparison with the task of introducing local number portability in the nation's largest MSAs. In 1997, our estimate is that there will be nearly 35 times more local and intraLATA toll calls than 800 calls in the Houston MSA. However, the FCC has allotted a shorter time from the order to the implementation of LNP than was allowed for 800 service. In addition, the LNP software in numerous network nodes will be new and unproven, where much of the 800 software had been proven over many months of field operation. Also, note that the 800 introduction was slipped 2 months from March 1, 1993 to May 1, 1993 at IXC request to avoid the need for **testing** during the fourth quarter busy season. The introduction of LNP is scheduled for **implementation** during the fourth quarter busy season. In order to avoid this time frame, it

will be necessary to slip the schedule by approximately three months (to allow limited testing during the fourth quarter and implementation during the first quarter).

The FCC's mandated approach of hurried introduction in the largest MSAs does not provide the means for a prudent introduction of LNP. A more reasoned approach would provide for:

1. A reasonable period of time for integration, testing, and soaking the new hardware and software in a multivendor network environment. A three month extension in the schedule would allow additional time for testing and avoid the implementation during the busy season.

2. Means for containing failures so they only affect a relatively small number of working lines. Such a means could involve limiting the LNP introduction to a smaller MSA (such as El Paso) or limiting the LNP introduction to a small geographic area within Houston.

3. Switch Failures Due to Rapid Installation of New Generic Software

3.1 Discussion

A new generic must be installed in each local switch in Houston. Installing a new generic in a switch always increases the chances of a failure. To meet the FCC mandated LNP 4Q97 deployment schedule for Houston, the installation interval will be extremely short, and, in fact, the usual soak period is likely to be cut substantially. The term "soak period" refers to the initial period of time in which new software is used in a actual working, but limited, environment to allow faults to be found and fixed before they affect service for substantial numbers of customers. Most installations of new generics/services/technology occur gradually over an extended period to allow a period of time so that problems can be found, fixed, and retested.

In this section, we attempt to determine several effects: 1) the increase in failures due to replacing a generic that is stable with a new generic, 2) the increase in failures attributable to extremely rapid introduction of a generic and 3) the increase in failures due to cutting the soak period for a software generic in half. We do not provide separate information for the LRN approach or the QoR approach. For either approach, a new software generic will have to be put in place. That is, we expect the results from this section to apply to either approach.

3.2 Increase in Failures Caused By Introducing a New Generic

We expect about 3 times more outages and failures following the introduction of a generic than for a stable generic. Higher outages are a result that is to be expected when software is first developed and deployed, regardless of manufacturer, and this is why such software is introduced and tested in a controlled manner. This factor of three assumes that the generic (or release) has

been soaked for an appropriate period for that type of switch. We define a stable generic as one that has been in place for about 1 year.

To get this factor of 3, we looked at a number of different metrics. The following table summarizes the information that was used to derive the factor of 3. The switch types have been masked to protect confidential information.

Table 7: Summary of Switch Generic Fault Information

	Stable Generic	New Generic	Factor
Software Faults for Switch A	18 per 500 system months.	67 per 500 system months	3.7
Software Faults for Switch B	18 per 500 system months	84 per 500 system months	4.7
Partial Outages for Switch C	.24 per system per year	.55 per system per year	2.3
Problem Reports for Switch D	.035 per system per month	.13 per system per month	3.7
Problem Reports for Switch E	.076 per system per month	.41 per system per month	5.4

As can be seen from the table, 3 may be a little conservative. Below we describe how we got the information in the table.

- For Switch A (specific software release), in the first 500 system months (after General Availability) there were 67 software faults discovered. After 2000 system months, there were 18 software faults found in the next 500 system months. That is there were 3.7 as many faults found in the introduction of the new service as later on.
- For Switch B (specific software release), the number of faults found at system month t is about $2.14/t^{.53}$. We obtained this by fitting a nonlinear regression model to the number of BCC Discovered Faults versus cumulative system months. We can use this model to predict the cumulative number of faults after the first 500 system months. After integration, we get about 84. After 2000 system months, we calculate there will be about 18 faults found in the next 500 system months. That is, we expect about 4.7 times as many faults found in the first 500 system months as compared with the systems months 2000 to 2500.
- For Switch C (specific software release), the number of partial outages per system per month is given in the following table:

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Table 8: Switch C Faults as a Function of Time

No. of Months After General Availability	Number of Partial Outages Per System Per Year
0	.55
1	.46
3	.42
6	.35
12	.24

At General Availability the number of partial outages per system per year was about .55. After the generic was out in the field 1 month. the number of partial outages per system per month dropped to .46 (over a 15% drop). After the generic was out in the field three months. the number dropped to .42 (nearly a 25% drop). After 6 months and 12 months , the number dropped to .35 and .24 respectively. This means at General Availability the number of outages is about 2.9 times higher than after the release has been out in the field for 12 months.

- The number of problem reports per system per month for Switch D (specific software release) during the first month after General Availability was .13 (34 problem reports in 260 system months). The number of problem reports per system per month after 1 year of General Availability was .035 (99 problems in 2795). The ratio of .13 to .035 is 3.7.

- The number of problem reports per system per month for Switch E (specific software release)in the first six months after General Availability was .41. The number of problem reports per system per month at month 12 is .076.

3.3 Increase in the Number of Failures Due to Rapid Introduction of LNP

We currently expect about a 12% increase in the number of outages in switches due solely to a rapid introduction of new generics in local switches due to LNP compared with the more normal speed of introduction of a generic. We do assume that the generic has the full normal soak interval. Table 9 summarizes the information that we used to draw this conclusion.

Table 9: Effect of Rapid Introduction on Switch F

	During Normal Speed of Intro. of a Generic	During Accelerated Intro. of a Generic	Percent Increase
Partial Outages for Switch F	.40 per system per year	.45 per system per year	12
Problem Reports for Switch F	.08 per system per month	.09 per system per month	14

Normal speed of introduction is based on the actual national implementation schedule of the specific software release of Switch F. Entries in the accelerated introduction column assume that all offices are cutover immediately after the Soak of the system (General Availability).